PEST MANAGEMENT EVALUATION

FOR SCHOOLS

Prepared for the

California Department

of Pesticide Regulation

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Prepared by:
Stacy K. Carlsen
Marin County Department
Of Agriculture

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1. Luke McCann, Director, Marin County Office of Education, P.O. Box 4925, San Rafael, CA 94913, phone: 415-499-5879, fax: 415-491-6625, e-mail: lmccann@marin.k12.ca.us.

2. Mary Grisier, United States Environmental Protection Agency, Children's Health Coordinator, Pesticide Program, Region IX, 75 Hawthorne Street (CMD-4-3), San Francisco, CA 94105, phone: 415-744-1095, fax 415-744-1073, e-mail: grisier.mary@epa.gov

3. Gregg Small, Executive Director, Pesticide Watch Education Fund, 450 Geary Street, Suite 500, San Francisco, CA 94102, phone: 415-292-1486, fax: 415-292-1497, e-mail: pestiwatch@igc.org.

4. Lila Wilkins, Director, General Services, Marin County Office of Education, P.O. Box 4925, San Rafael, CA 94913, phone: 415-499-5857, fax: 415-491-6625, e-mail: lwilkins@marin.k12.ca.us.

5. Marc Lame, Director, School of Public and Environmental Affairs, Indiana University, Bloomington, Indiana 47405-2100, phone: 812-855-7874, fax: 812-855-7802, e-mail: mlame@indiana,edu.

6. Marc Lea, San Luis Obispo County Department of Agriculture, 2156 Sierra Way, Suite A, San Luis Obispo, CA 93401-4556, phone: 805-781-5907, fax: 805-781-1035, e-mail: mlea@co.slo.ca.us.

7. Ray Palmer, Pest Control Supervisor, San Diego City Schools, 4860 Ruffner Street, San Diego, CA 92111-1522, phone: 619-627-7223, fax: 616-279-3582.

8. Elisa Lynch, Bay Area Community Organizer, Pesticide Watch Education Fund, 450 Geary Street, Suite 500, San Francisco, CA 94102, phone: 415-292-1489, fax: 415-292-1497, e-mail: elisalynch@earthlink,net.

9. Ron Warfield, Manager of Operational Services, Novato Unified School District, 1015 7th, Novato, CA 94947, phone: 415-898-8103, fax: 415-898-3134, e-mail: warfield@nusd.marin.k12.ca.us.

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ABSTRACT:

The purpose of this pest management evaluation is to look at the California public school system and report on how schools manage their pests, what information exists on the use of pesticides in schools, what manuals and education materials exist that encourage less use of pesticides, and what are some challenges and innovations in adopting reduced-risk pest management strategies. Pesticide use report data was reviewed in order to determine what pests exist and what pesticides are used in certain school districts. A previous pest management evaluation, prepared for the California Department of Pesticide Regulation (contract #97-0269), provided information about common pests, alternative control strategies, and a pesticide cost analysis.

Schools must deal with complex pest problems, public concerns about pesticides, and limited resources to implement integrated pest management programs. Although educational materials are available covering "School Integrated Pest Management", there is a lack of baseline information to evaluate the IPM system. Lacking an evaluation of component parts of the system prevents a full analysis to determine program cost. The challenge is to establish baseline information, not only on pesticide costs and pest-related damages, but to identify training and support activity levels, as well.

Controlling rodents and cockroaches in schools is important because they can carry disease. Termites and ants can threaten school structures and cause damage. Bees and wasps can inflict painful and sometimes life-threatening stings and cockroaches can transmit life-threatening bacterial diseases. It is important these pests are controlled and simply banning the use of pesticides in a school setting does not address these problems. Improving communication through a quality team approach and bringing together experts that can explain technical solutions is necessary. Do liquid organophosphate pesticides vapors present a health problem in schools, and do they contribute to non-point source pollution problems? Best management practices are needed for pesticides used at the local school level. There are hundreds of registered pesticides that can be used in schools. This evaluation is very fundamental and is not a full-scale statistical survey on pest problems, or pesticides used. However, it does outline some of the more common pests, pesticides, and alternative pest control practices used in California schools.

PEST MANAGEMENT EVALUATION OF SCHOOLS:

A. Description of Schools in California

California schools operate under the direction of the California Department of Education. Delaine Eastin is the State Superintendent of Public Instruction, and is responsible for the Department's executive and administrative function, and is Secretary and Executive Officer for the State Board of Education. The mission of the California State Board of Education is to create strong, effective schools that provide a wholesome learning environment through incentives that cause a high standard of student accomplishment, as measured by a valid, reliable, accountability system.

In fiscal year 1999-2000, over $47 billion was devoted to California's 988 school districts and 58 county offices of education to support K-12 education. School maintenance accounted for 8.4% of the expenditures. In 1998-99, there were 5.8 million students enrolled in public schools. The majority, (4.1 million), of the students were enrolled in kindergarten through 8th grade. Ethnicity and language types identified in schools are very diverse. Ethnic groups include American Indian 0.9%, Asian 8.1%, Pacific Islander 0.6%, Filipino 2.4%, Hispanic 41.3%, African American 8.7%, White 37.8%, Multiple 0.3%. Languages spoken include English, Spanish, Vietnamese, Hmong, Cantonese, Filipino, Khmer, Korean, Armenian, Mandarin, Lao, and various others.

The California Department of Finance (CDF) estimates that the state will add over 300,000 new students in the five years from 1997-98 to 2001-02, bringing the total number of K-12 students to nearly six million. Many school districts are struggling to catch up with the housing needs caused by this enrollment growth. It has been estimated that over 400 new schools are needed to accommodate this new student population. Compounding the problem are reports published by the California Department of Education (CDE) that 55% of California's public school buildings are over 30 years old. Many school buildings are in poor condition and are in need of basic repairs and routine maintenance. There are some school facilities that are now in a state of serious physical disrepair. Facility condition and maintenance play a major role in determining if pests will be detected. These conditions play a significant role in various pest problems frequently experienced in classrooms, kitchens, and playgrounds.

The most common pests found in schools include ants, cockroaches, flies, rats/mice, weeds and bees. In many situations, these pests were controlled using pesticides. Building repairs and maintenance and implementing reduced-risk pest control practices in new building designs and construction specifications could reduce pesticide use in California schools, and prevent pest problems.

B. California School Regions

There are 1046 California School Districts, comprised of over 8,300 public schools in California. The state can be divided into various zones based on general climatic conditions. The following regions were selected for purposes of this evaluation:

Region #	
1	North Eastern
2	San Joaquin Valley
3	Coastal
4	South Eastern
5	South Coastal
6	North
7	North Coastal

School districts vary greatly in size, enrollment and employment. For example, Alpine County has two (2) school districts with an enrollment of 140. There are only 3 elementary schools in the county. There are 18 employees in the district. In contrast, in Los Angeles County, there are greater than 1.5 million K-12 students enrolled in 1,790 schools. There are greater than 70,000 regular employees of the district. The K-12 school budget is $3.2 billion.

This great contrast between school districts reflects the diversity of public schools that exists in California. However, as a general rule, most school districts deal with the same pests no matter what region of the state the district is found. This is largely due to the environment in which these pests are capable of inhabiting. A Pest Management Evaluation (Contract #97-0269) prepared for CDPR, which evaluated various school districts throughout the state, identified a common set of pests that inhabit the schools. They included ants, cockroaches, bees, snakes and skunks. However, the presence of certain other pests, i.e. scorpions, were limited to Southern California desert/coast region.

C. Cultural/Regional Practices

Pest management practices in schools are very diverse. In some situations, pest control is strictly handled by only licensed pest control operators. This allows decisions to be made by trained individuals to which pest control alternatives are determined. In certain circumstances, pests are controlled using pesticides. Pesticides are not always the first choice in pest control. In fact, some schools in California have adopted policies and pest management guidelines requiring the use of pest management alternatives before any pesticides can be used. In these cases, a Pest Manager is assigned to be a clearinghouse for making decisions about pest control options. For example, Los Angeles County, San Diego County, and Ventura County, have established Integrated Pest Management programs. In these counties, pre-clearance is required for pesticide applications. In contrast, many schools have no evaluation systems in place to determine the status of pest problems when detected, or how to control them. In this instance, a typical procedure is the pest problem is communicated to an individual who is not fully trained in pest identification and control options. Expedient steps are often taken to reduce the "pest" from the source. In

many cases, this is done to reduce disruption in the classroom. In this haste, alternatives are not considered and pest control options may be carried out that may create more risk than the pest being present.

In this situation, a non-trained or non-licensed individual may carry out pest control. They may use pesticides that are not registered for use to control the pest. In these instances, pesticide use may give immediate pest control, but not a lasting solution to the problem. Repeated efforts to control pests with pesticides is not wise. In addition, language barriers covering instruction on pesticide safety can be a problem. Misinformation or information not understood by employees using pesticides creates a huge liability for schools. The extreme case includes unlicensed, untrained individuals using inappropriate or unregistered products to control unidentified pests.

In some areas of the state, certain types of plants are labeled "invasive" and the same plants in other areas are protected. The eucalyptus tree is such a plant. In some instances, these trees are cut down and the stump treated with herbicides to prevent re-growth of suckers. This same tree may be protected from removal because of esthetics or habitat protection. A pest in one region of the state does not mean it is a pest somewhere else. The frequency of some pest problems is often limited to biological or climatic regions of the state. The scorpion and spiders are more abundant in the desert regions and are more likely to be a problem there than elsewhere in the state. Termites are more likely to infest school buildings in the coastal regions of the state. Cost to control this pest can be very high. Relying on proper maintenance of structures and designs of new structures can reduce pest problems.

D. Insect/Mite Control

Ants

There are three reasons why ants can become a problem; 1) worker ants coming inside for food or water, 2) winged reproductives ("the swarmers"), emerge inside, or 3) ants colonize and nest in walls or other structures within the building. Different species of ants feed on sugar, fat, or protein. Most species nest outside. Winged ants are "swarmers" - the kings and queens. Large numbers of winged ants indoors indicate an indoor infestation. Ants complete their lifecycle in four stages: egg, larvae, pupae and adult.

Common ants indoors in California include Pharoah, thief, field, Argentine and carpenter ants. Ant problems in the winter indicate an indoor colony. Proper identification will help in finding the nesting site. Most ant problems do not require professional pest control help. Ants live in colonies that may have thousands of individuals. Only the queens can lay eggs. To control ants you must find the nest and kill the queen. This can be done as a spot treatment or with baits that are taken back to the colony. General sanitation and eliminating food sources can be very effective.

Chemical Control

- Soapy water will knock down workers that are present. Individuals can then be wiped up.

- Insecticide baits are often recommended to control ants in schools. Workers will take poison back to the nest and feed it to the young and queen. Some ant baits are for sweet feeding ants, some for protein feeding ants, and some for both types. Active ingredients will include less toxic products such as boric acid, sulfuramid, abamectin, hydramethylnon and fipronil. Baits

come in plastic stations, gels and pelleted baits. Different treatment sites will require different formulations.

- If colonies are found they can be spot treated. In walls, insecticide dusts containing synthetic pyrethroids, boric acid, drione or silica aerogel can be used. Synthetic pyrethoids can be used to control outdoor nests.

- Fire Ants are a regulated pest and require special control procedures.

Alternatives

Pharaoh ants (*Monomorium pharaonis*) are strictly an indoor pest. The ants are yellow to red and only 1/16 inch long. Pharaoh ants eat a variety of foods including soap, toothpaste, fats, grease, sweets, and dead insects. Treating the problem with insecticide sprays often force the ant to bud into multiple colonies and will make the infestation worse over time. Baits made specifically for pharaoh ants are the best treatment. Pharaoh ants have multiple queens in a colony and do not swarm.

Thief ants (*Solenopsis molesta*) are commonly called grease ants and are the smallest ant (1/20 inch) found indoors. They usually nest outdoors and forage in well defined trails during mid to late summer. Preferred foods include grease, meats, cheese and peanut butter. Nests are very difficult to find, and these ants should be baited. Barrier treatments will slow the migration indoors and often force the ants into outdoor foraging patterns.

Field ants (*Formica* spp.) look similar to carpenter ants but do not nest or forage indoors very often. They construct large mound type nests in the soil, with some species constructing very large mounds. Spot treating the individual nests is commonly practiced.

Argentine Ants *(Linepithema humile)* are light brown and around 1/8 inch in size. They frequent structures, nests in a wide variety of places outdoors and indoors. This insect will feed on sweets, protein and grease.

Cultural Control

- General sanitation. Eliminate food sources. If an ant finds food they recruit hundreds more as long as food is available. If the food is removed, ants will be forced to look elsewhere and should stop the habit of coming indoors.

- Wash trash containers, recyclable items; clean up all spills.

- Seal all food, especially sugar containing products in tight-fitting glass or plastic containers.

- Caulk entrances and points of entry to keep ants outdoors.

- Winged ants can be cleaned up with a vacuum.

Biological Controls

Ants are vulnerable to parasitic attacks. However, the prospect of this practice to control ant infestations has not been pursued on a commercial basis.

Other Issues – Reduced Risk Options

An effective nonchemical technique for ant control is pest-proofing or exclusion, i.e., finding out where the ants are getting into a structure and then sealing or caulking that area. In their natural habitat, foraging ants prefer to follow preexisting edges and other structural features in the environment to and from their nest. This natural behavior predisposes ants to travel along the structural guidelines that we provide in the urban environment, such as wires, pipes and conduits. Therefore, an effective strategy for keeping ants out is pest proofing at the points of entry of these utility lines into a structure. Caulk cracks and crevices around the foundations of buildings to keep ants out. Eliminate cracks and crevices in kitchens and other food preparation and storage areas. Store foods that are attractive to ants (sugar, syrup, honey, and other sweets) in closed containers that have been washed to remove any residue from outer surfaces. Rinse out empty soft drink cans and bottles before putting them in the recycling bin. Do not store garbage indoors. Be thorough in cleaning up grease and spills. Inspect your potted indoor plants for evidence of infestation. If you do find ants nesting in the soil, discard the plant, or place the plant in a bucket or plastic trash can outdoors and fill the container with water to the top of the house plant pot to force the ants out of the soil. Wash the container in soapy water. Do not plant trees and shrubs that are highly susceptible to aphid infestation next to buildings.

Baits capitalize on the social behavior of ants, whereby scout ants recruit nest mates to a newly discovered bait, and these recruited ants return to a centrally located nest to share the bait with the rest of the colony. Toxic baits (stakes, bait stations) can be effective in controlling ants because they get poison into the nests when nests are difficult to find or treat directly. Control may take several weeks. When other food sources are not available, workers are attracted to the bait, carry it back to the nest, and give it to other workers, larvae, and reproductive forms, leading to elimination of the entire colony. Since ants will not eat bait if more attractive food sources are nearby, sanitation must precede baiting. Be sure to remove any particles of food or other sweet substances from cracks around sinks, pantries, and other areas.

Bait stations should be placed indoors so that they are easily accessible to ant pests but not accessible to small children or pets. The effectiveness of baits will vary with the ant species, the bait material, and the availability of alternative food sources. Pharaoh ants are the easiest to control with baits because the pest control industry has spent a lot of time and money developing good baits for this particular ant.

Outdoors, bait stations should be placed around the foundation and at nest openings, if they can be found. Ant stakes (enclosed bait) may be placed near nests or on ant trails beneath plants. For the most effective and economical control, treat in early spring when ant populations are low.

Red Imported Fire Ant (RIFA)

Common in several southeastern states, red imported fire ants (RIFA) are new to California, and have recently been found infesting several residential and commercial areas in Orange, Los Angeles, and Riverside counties. RIFA will typically make dome-shaped mounds or will build their nests around structures such as trees, pipes, and walls.

Chemical Control

Insecticide baits to control fire ants are available for broadcast application in infested areas. The insecticides include Hydramethylon (Combat) and Fenoxycard (Award). The latter product is a restricted use product and must be applied by a licensed pest control operator. Ant mounds can be drenched with carbaryl, chlorpyrifos, and diazinon.

Alternatives

The pesticides registered for controlling this pest are very effective. They must be applied in a proper manner to protect the public health and safety. The bait products can be applied as an individual mound treatment, but are best used as a broadcast treatment. These treatments take several weeks to take effect and control the ant.

Cultural Control

Mound treatment with boiling water will be about 60 percent effective, however, there are hazards associated with using this technique, i.e., burning oneself with hot water.

Biological Control

Spiders, lizards, and some birds will eat winged queen ants.

Other Issues – Reduced Risk Options

Because this ant is a regulated pest, reduced-risk control options should be given consideration and used if possible. However, all appropriate tools should be employed to control this serious pest. All pesticide options (dust, liquids, granules, and baits) are needed to keep this pest in check.

Cockroaches

All roaches need food and a source of water. Infestations are most likely in kitchens, teachers' lounges, food storage areas, and bathrooms. Once established, roaches use plumbing and electrical wires to move to other areas. German roaches are a common problem in California schools.

Continuing re-infestations may be associated with food vendors or in some cases roaches are carried in by students. Roaches can mechanically carry bacteria and are a leading cause of allergy problems. Sticky traps should be used to monitor problems. Place traps under refrigerators, dishwashers, and sinks. Traps should be monitored on a regular basis by staff or pest control operator.

Chemical Control

- Cockroach problems are difficult and should be handled by a pest control operator (PCO). A thorough inspection should be done before treatment.

- The use of baits and gels should be the primary treatments. Crack and crevice treatments will be more effective and cut down on exposure. After treatment some areas can be sealed or caulked.

- Less toxic materials include insect growth regulators (IGR's) such as hydroprene and priproxyfen. IGR's take a few weeks to work.

- Boric acid, silica aerogel, and drione dust can be used in voids.

- Baits containing abamectin, boric acid, and hydramethylnon are effective.

- Clean out treatments should be scheduled in the summer when students are not present.

Cultural Control

- Sanitation is important especially with the use of baits, but will not eliminate existing problems alone. Any food brought into classrooms can increase problems.

- Repair leaking pipes, faucets, and other water sources and caulk all cracks.

- All food including pet food in classrooms should be sealed tight, insect-proof fitting containers.

- Garbage should be removed daily and sealed in plastic bags.

- Try to eliminate corrugated cardboard storage boxes and other roach harborages.

- Vacuuming in hiding places or freezing of small articles can be used in some situations to control roaches.

Flies

There are four or five species of flies that can be found breeding indoors. If fly problems are seasonal or reoccurring, the source may be outside. Proper identification will help lead to the breeding source and the type of sanitation needed to control the fly problem. Flies can breed quickly and go through a generation in 10-14 days.

Fruit flies breed in yeast associated with moist, fermenting organic material in trashcans, recycling bins, compost, and sour mops.

Drain flies breed in floor drains, sink overflows, and unused urinals, sump pumps, and sewers.

Filth flies such as houseflies and blowflies breed in garbage and animal waste. They do have a public health concern, as they are capable of mechanically transmitting a number of diseases.

Fungus gnats breed in potting soil of indoor plants and in moist organic matter.

Cluster flies seek shelter in buildings during the fall.

There are many different types of flies. Understanding the specific biological and environmental requirements will be important for control. Adult flies are very mobile and are not always directly associated with the source of the problem. Most fly problems can be traced to isolated breeding sites. The worm-like maggots are less mobile and can be found crawling in or near the food source. If these can be found and eliminated the problem should clear up in a few days. If the source can not be found, short-term control using an aerosol knock down insecticide will kill adult flies but will have to be repeated every 3-5 days.

Chemical Control

- Chemicals only kill adult flies and do not deal with the source of the problem.
- Aerosols containing pyrethrum or synthetic pyrethroids will give quick knock down.

Alternatives

There are a number of species of vinegar flies also known as pomace or fruit flies, (*Drosophila* spp.), found breeding indoors. Adults are 1/16 to 1/8 inch, light brown and often have bright red or maroon eyes. They are found hovering around over ripe fruit or fermenting material. Breeding sites contain decomposing material that contains yeast and other microorganisms associated with fermentation.

Drain flies (also called moth or sewer flies, family *Psycodidae*) are found in the slime layer in floor drains, sewers, overflows on sinks and pools, and other damp organic matter. Adults are small, hairy, dark, weak flying gnats that often congregate in sinks and bathrooms. They rest with wings flat on the back and have a triangular or delta shape. Adults are often found some distance from the source. Hot water, drain cleaners, or other flushing materials that eliminate the slime should solve the problem.

Blowflies are metallic green, blue, or shiny black flies about the size of houseflies. They breed on dead, decaying animals, animal waste, and high protein garbage. Infestations are usually intense but short-lived.

True houseflies are almost always associated with a human generated source. They breed a generation within 14 -30 days on garbage, human and animal waste, wet animal feed, and rotting fruits and vegetables. A number of human pathogens have been mechanically transmitted by houseflies, and their presence is a public health concern. Sanitation and elimination of food should always be the first line of defense. In summer the potential of an outside source of flies requires various elimination practices including caulking, proper screening, air doors, or other barriers.

Humpback flies (*Phoridae*) and others. There are three or four fruit fly sized flies that are associated with wet organic matter or animal waste. Adults are found congregating around garbage cans, sinks, drains, or windows. A common source is broken sewage pipes that leak wet organic matter under concrete slabs or within walls. Long term control relies on repair and source reduction. Proper identification of the type of fly involved will give clues to the breeding site.

Fungus gnats are 1/10 inch long, dark colored flies with many segmented antenna. Adults create a nuisance indoors and the larvae are associated with damp decaying vegetable matter, high organic plant potting soil or with fungus growing within walls.

Cultural Controls

- When problem areas are found, a thorough cleaning is needed.
- After the area is cleaned, maintain it more often (e.g. empty trash more often, rinse out recyclables before putting them in the recycling bin, clean drains more often).
- Wash trash receptacles regularly.
- Keep garbage in sealed trash bags.
- Screen all windows that will be opened.
- Maintain screening.
- Have all exterior doors be self-closing and keep them closed when not being used.

The best control is to identify and seal entry points. Attic, roof, and overhang vents should be screened with fine mesh screen. Openings in siding, overhangs and around windows, skylights, and doors should be caulked.

Honeybees, Wasps and Africanized Honeybees

Bees and wasps are some of the most important stinging insects that people encounter. Some of the more common bees and wasps in California include European honeybees, bumble bees, yellowjackets, paper wasps, and mud daubers. Africanized honeybees, which are close relatives of European honeybees, are a new threat to California.

Africanized Honeybees (also known as killer bees) became established in Texas in 1990 and have spread to other southern states. In 1995, they were found in the Coachella Valley in California and they are expected to migrate throughout the state. People can coexist with the Africanized honeybee by learning about this bee and its habits and taking necessary precautions, which can lower the risk of being injured.

Africanized honeybees are closely related to European honeybees used in agriculture for crop pollination and honey production. The two types of bees look the same and their behavior is similar in many respects, although there are some differences. Neither is likely to sting when gathering nectar and pollen from

flowers, but both will sting in defense if provoked. A swarm of bees in flight or briefly at rest seldom bothers people. However, all bees become defensive when they settle, begin producing wax comb, and raising young bees. Africanized bees are very aggressive if disturbed.
Africanized honeybees nest in many locations. They can be encountered in empty boxes, cans, buckets or other containers, old tires, infrequently used vehicles, lumber piles, holes and cavities in fences, trees, sheds, garages, other outbuildings, low decks, spaces under buildings, and in the ground.

Yellowjackets (*Vespula spp.*) and *Paper Wasps* (*Polistes* spp.) are beneficial insects in that they are predators of houseflies and insect pests that damage landscape trees and crops. However, several species scavenge for meat and sweets, seek out garbage cans, and are familiar pests at picnics and backyard barbecues. Since they are beneficial insects, control them only when necessary. Yellowjackets and paper wasps do not reuse their nests the following year. Knowing this fact may help you to determine whether to implement control measures and risk getting stung if the nest is located in a rarely used part of the yard. If the yellowjackets are left alone, the nest will usually disintegrate during the winter. If the nest is located under the eaves of the house or in the attic, only remove it after the yellowjackets are gone because the nest may serve as a home for carpet beetles or other pests.

Chemical Control

Underground Nests. Aerosol formulations of insecticides effective against aerial nests will also control subterranean nests. Direct the material carefully into the entrance hole after dark. During the day, a bee suite should be worn to avoid getting stung. After treating, do not plug the entrance hole so returning foragers can enter the nest and be killed by the insecticide residue.

Nests in Wall Voids. Aerosol formulations that control aerial nests can be used to control nests in wall voids. If dusts are used, plug the entrance hole with steel wool and dust the wool and surrounding area with insecticide. Returning foragers chew at the steel wool coated with insecticide dust and succumb. Wear protective clothing (bee suit, veil, gloves) during the entire operation.

European Honeybees (*Apis mellifera*) are important to agricultural production in California as pollinators of fruits, vegetables, flowers, and seed and forage crops (alfalfa, clover), and as producers of honey and wax. Up to one-third of the average diet depends on honeybee pollination thus, hives of European honeybees managed by beekeepers play an important role in our lives. However, in and around the household, honeybees are unwelcome guests because they can sting people and pets. Honey bees collecting water or gathering pollen and nectar from flowers are not aggressive but will sting if provoked or harmed. They defend their hive or nest and will attack and sting anyone in their territory believed to be a threat to the colony. Thus, honeybees are most likely to sting when an established colony is disturbed. To reduce the risk of being stung, it is important to learn about bee behavior and to remove unwanted colonies of bees near the school site.

Chemical Control

Before beginning any control measures of a colony inside a wall, it is necessary to consult with a pest control specialist to determine the location of the colony in relation to the flight entrance and, if possible, determine the number of entrances. The nest may be far enough away from the entrance(s) that insecticides applied at the entrance(s) will not reach the bees.

Insecticides labeled for use on bees are the safest, quickest, and most effective materials for killing colonies. It is prudent to contact a professional pest control operator to handle the job.

Biological Control

When bees threaten health and human safety, immediate controls are preferred. Biological controls would not be considered since these insects are overwhelmingly beneficial in nature.

Other Issues – Reduced Risk Options

Garbage cans on school grounds should have removable domed tops with vertical spring-loaded swinging doors. The cans should be emptied frequently enough to prevent the contents from impeding the closure of the lid. The lids and cans should be periodically cleaned of food wastes. Disposable liners can be used and replaced when soiled or damaged.

Trapping with a sturdy trap and attractive bait can significantly reduce yellowjacket numbers if a sufficient number of traps are used. There are a variety of traps on the market.

Vacuuming is not recommended unless it is done by a professional experienced in handling stinging insects.

Vacuuming can be particularly effective where nests occur in wall voids, in emergencies where nests have already been disturbed, and in environmentally sensitive areas where nests should not be treated with insecticides.

Spiders

Spiders eat insects. Larger numbers of spiders and spider webs means there are many insects available for food. Schools near lakes often attract large numbers of flying insects to night-lights, as does general security lighting on buildings. Spiders will build webs under eaves, in corners, or on shrubbery. Spider populations will fluctuate from year to year, but will be highest in the late summer. Indoors, the highest numbers will be in storerooms, crawl spaces, and basements. Because there is so little food available indoors, spider populations will be limited unless they have an easy time migrating from outdoors.

Chemical Control

- General surface sprays are not very effective and therefore should not be used.
- Individual spiders can be controlled with non-residual aerosols containing pyretherin or resmethrin.
- In the few cases where large numbers of spiders and spider webs disfigure the building, spot treat problem areas around doors, windows and other openings on outside of building before students begin the fall term. Use a wettable powder or microencapsulated synthetic pyrethroid compound.

- Dust formulations can be used in crawl spaces or as a crack and crevice treatment in storerooms.

- Power washing or brushing of walls may be needed to remove debris and may be as effective as spraying.

Cultural Control

- If hunting spiders are being found inside in large numbers, check door sweeps, electrical openings, vents and other areas on the outside of buildings and seal up these access points.

- Keep vegetation along foundation to a minimum, preferably a 24-inch band that is vegetation free.

- Vacuum indoors to remove webs and egg cases.

- For indoor nesting species, remove clutter in storage rooms. Keep boxes away from walls.

- Promote good ventilation in storerooms, which will help eliminate insects that spiders feed upon.

- Use glue board monitoring traps to follow spider activity and problem spots.

- Many times spiders will concentrate around lights on the outside of buildings. Change to sodium vapor or other lighting that attracts fewer insects or move lighting away from the building on poles.

Food Pests

A large number of beetles, several moths, psocids (booklice), and some mites commonly infest various food products. In general these insects feed on any plant material including spices, flour, vegetable seeds, tea, dried flower arrangements, dried herbs and fruits, chocolate, powdered milk, pet food, and grain. They will breed continually at normal indoor temperature. The exact situation they are found in will influence what control strategies are used, but the source of the infestation must be found or destroyed for total control.

Indian meal moth is the most common indoor breeding moth in California. Adults are 1/3 inch long and have a two toned wing, and a tan to gray wing base with a coppery-reddish or bronze zone on the outer two-thirds of the wing. Larvae are creamy colored 1/2-inch caterpillars with a green or pink tinge and are associated with over 80 commodities including nuts, dog biscuits, dried fruit, birdseed, chocolate, flour, tea, and stored grain. These caterpillars spin large amounts of silk webbing in and over food. Larvae often migrate a distance away from the food source to spin a cocoon in bag seams, cracks and crevices, or other sheltered sites.

Drugstore beetles (*Stegobium paniceum*) are small, cylindrical reddish brown beetles that are 1/8 inch long and have their head tucked so it can not be seen from above. Larvae are small c-shaped grubs. Adults can fly, and can penetrate most paper packaging, leaving cylindrical holes in packaging. Infestations are

associated with cigars, spices such as red and cayenne pepper, drugs, and cereal products. Adults are attracted to windows and other light sources.

Granary weevil and related species can only breed on whole grain or seeds. The adults are 1/8-inch dark brown beetles with an elongated snout. Adults cannot fly and infestations are often seen close to rice, whole grain corn, wheat, or in sunflower seeds.
The *red flour beetle* (*Tribolium castaneum*) is a serious pest of flourmills, bakeries, homes, and cafeterias where they infest cereal products, crackers, noodles, and other sources of milled grain products. Their small 3.5mm size allows these reddish brown beetles to easily penetrate packaging, and to hide in cracks in shelving. High populations will discolor and alter the taste and baking quality of flour.

Occasional Invaders

A number of the insect problems in schools come from insects that migrate from outdoor sources. Many problems are seasonal with the fall being a prime time for insects to move into buildings. Crickets, boxelder bugs, cluster flies, millipedes, and ground beetles are examples of insects that may move indoors. The source of these insects could be trees and shrubs near the structure, weedy vacant lots, security lighting, or organic mulches around the foundation. Insects could be seeking water, shelter, or come indoors by accident. These nuisance invaders are harmless and do not bite, but can create major concerns when they show up.

Chemical Control

Barrier or perimeter treatment is the application of pesticides around the outside foundation of a structure that is intended to kill insects as they migrate through the area, but before they get indoors. For many of these insects, barrier treatments will be a cosmetic cure. With the thought in mind of reducing pesticide exposure, barrier treatments are not usually recommended for schools.

Sprays, dusts, or granular materials are applied to the ground in a band 4-10 feet wide around and adjacent to buildings. Treat the building from the ground up to a height of 2-3 feet. As mentioned above, treating cracks and openings around windows, pluming, and doors is more effective and can lessen the need for broadcast treatments. When large numbers of insects are migrating in, the 80-95% kill rates of many treatments may still allow a moderate number of insects to invade the structure. Apparent control failures also occur when broadcast treatments are applied after a number of insects have crawled into wall voids. For insects that are migrating from fields or weedy lots, it may be more effective to place the barrier at the edge of the property and kill the insects before they get to the structure.

Cultural Control

One of the most often missed opportunities is to insect proof or build pests out. If large numbers of insects are migrating indoors they must be having an easy time getting in. Check for proper screening (40-mesh) of windows and vents, and observe air intakes for holes or filter problems. Caulk openings near water faucets, around windows and doors, between lose fitting siding, around electric or telephone wires, and other openings. Cracks in foundations should be sealed or patched. Doors should be tight fitting with weather-strips to keep out crawling pests. The space between foundations and siding and poor fitting window frames are common weak points that allow insects to crawl into wall voids and gain entrance to the building. These sites can be caulked or stuffed with copper wool or similar products.

Habitat elimination can be achieved with removal of organic bark mulches, vines, weeds, and other vegetation near foundations. This will reduce the chance for pest problems. In many institutional settings a 2-foot vegetation free barrier is standard, using rock, gravel, or bare soil.
Removal of boxelder, birch, poplar and willow trees planted close to buildings should be considered if they are the source of the invading insects. High moisture levels increase problems with earwigs, millipedes, springtails, and sowbugs.

Many insects are attracted to outdoor lighting. They will be attracted to security lighting at night, and sneak into the building when the sun comes up. Substituting sodium-vapor lights for mercury vapor near entrances or using dicrom yellow lights for incandescent floodlights or standard bulbs will attract fewer insects. Decoy lights can be placed away from buildings to draw insects away or place security lighting on posts that site onto doors rather than placing above entrances. Ground beetles, cutworm moths, mayflies, and click beetles are all common invaders that are attracted to lighting.

Head Lice

Head lice only survive and breed on people. They are a medical problem and treatment should be left to parents and medical staff. Head lice cannot survive off their human host for more than 48 hours. Because of increased resistance to prescription and non-prescription treatments, head lice have become more difficult to control, leading to more pressures on schools to provide treatments.

Chemical Control

Chemicals should not be used anywhere in schools to control lice. Infestations are most likely from personal contact or sharing infested articles such as combs, brushes, and hats. School nursing staff can help educate parents as to proper louse control in the home.

Cultural Control

Treatments in classroom:

- Sleeping mats and rugs should be avoided.
- Vacuum furniture and floor rugs thoroughly.

- Clothing (coats, hats etc.) can be isolated in individual plastic bags for each student.

- Bagged articles can be placed in the freezer overnight or items can be left isolated for 21 days.

- Washing of clothing in hot water and a hot dryer will kill lice.

Personal treatments:

- Because treatments do not kill 100% of the eggs it is important to retreat within 10-14 days for control.

- Nit combs are constructed to remove lice and eggs from the hair and are very effective if used properly.

- The use of oils such as olive oil and coconut oil has shown promise if left on the hair for at least 8 hrs. Consult with student nurse or local public health nurse for more information.

- Seek medical assistance for specific control recommendations.

When problems are discovered in a classroom, all children should be inspected for active lice. Some school districts will demand a "no nit" policy and not allow students back into the classroom with any sign of lice.

E. Weed Control

There are numerous weed species inhabiting school grounds in California. Weeds are categorized according to the duration of their life cycle. There are annuals, biennials, and perennials. Weeds occupy an assortment of habitats. They generally grow in places where soil is bare or disturbed. They can be found along fence lines, ball fields, graded areas, and cracks in pavement and flowerbeds.

Weed management in landscape plantings is often difficult due to the complexity of the planting. Usually more than one species is planted in the landscaped area and there is a mix of annual and perennial ornamentals. The great variety of ornamental species, soil types, slopes, and mulches creates the need for a variety of weed management options. There are also considerations regarding public concern about the use of chemicals to control weeds. The choice of a specific weed management program depends on the weeds present and the types of turf or ornamentals planted in the area. Because of the many variables, weeds in landscape plantings are controlled by a combination of nonchemical and chemical methods.
Common weeds in school landscapes:

Annuals	Biennials	Perennials
Wild barley	Bristly oxtongue	Bermuda grass
Crabgrass		Bind weed
Groundsel		Nutsedge
Pigweed		

Purslave
Spurge

Chemical Control

When an area is weed-free, preemergence herbicides can be used to prevent the germination or survival of weed seedlings. Preemergence herbicides must be applied before the weed seedlings emerge. Examples of preemergent herbicides include isoxaben (Gallery); metolachlor (Pennant); oryzalin (Surflan); oxadiazon (Ronstar); pendimethalin (Pendulum, Pre-M); prodiamine (Barricade); napropamide (Devrinol): and DCPA (Dacthal). Surflan, Pendulum, Barricade, DCPA, and Devrinol control annual grasses and many broadleaf weeds and can be used safely around many woody and herbaceous ornamentals. Pennant has become popular because it controls yellow nutsedge as well as most annual grasses. Gallery is used for control of broadleaf weeds.

Combinations of herbicides increase the species of weeds controlled and provide effective control of grasses and many broadleaf weeds. Commonly used combinations include tank mixes of the materials listed above or oryzalin/benefin (XL), oxyfluorfen/oryzalin (Rout), and oxyfluorfen/pendimethalin (Ornamental Herbicide II).

Perennial weeds should be controlled before planting trees and shrubs using geotextile fabrics with a shallow layer of mulch or use a thick layer of mulch without a geotextile. Use a preemergence herbicide, if needed, and supplement with spot applications of postemergence herbicides and/or hand weeding. Perennial weeds may be controlled by manual removal, spot applications of glyphosate or glufosinate, or, in some instances, dormant season applications of preemergence herbicides. Escaped weeds may be controlled manually or with spot applications of postemergence herbicides.

Cultural Control

Frequent hand removal of weeds when they are small and have not yet set seed will rapidly reduce annual weeds. If weeds are scattered at a site, hand weeding may be the preferred management method. Hand weeding can be time-consuming and costly but should be included in all weed management programs to keep weeds from seeding.

Mowing can be used to prevent the formation and spread of weed seeds from many broadleaf weeds into cultivated areas by cutting off flower heads. However, weeds that flower lower than the mowing blades are not controlled. Repeated mowing tends to favor the establishment of grasses and low-growing perennial weeds. Mowing of some ground covers can rejuvenate them and make them more competitive against weeds.

A mulch is any material placed on the soil to cover and protect it. A mulch suppresses annual weeds by limiting light required for weed establishment. Many types of landscape mulches are available. The most common are bark and other wood products, and black plastic materials. Other products that are used include paper, yard compost, hulls from pecan, cocoa, or buckwheat, municipal compost, and stones.

Other Issues - Reduced Risk Options

Synthetic mulches, which are manufactured materials that are called geotextile or landscape fabrics, have been developed to replace black plastic in the landscape. Geotextiles are porous and allow water and air to pass through them, overcoming the major disadvantage of black plastic. Although these materials are relatively expensive and time-consuming to install, they become cost-effective if the planting is to remain in place for 4 or more years.

Organic mulches derived from wood chips, sawdust, and yard waste are useful in reducing weed problems in schools.

The thickness or depth of a mulch necessary to adequately suppress weed growth depends on the mulch type and the weed pressure. The larger the particle size of the mulch, the greater the depth required to exclude all light from the soil surface.

When weeds escape preemergence herbicides or geotextile fabrics, postemergence herbicides can be used to control established weeds. Postemergence herbicides control existing plants only and do not give residual weed control. Their primary function is to control young annual species, but they are also used to control perennial species. Cleothodim and fluazifop selectively control most annual and perennial grasses (except fluazifop does not control annual bluegrass, a common winter annual grass). Glufosinate (Finale), diquat (Reward), and pelargonic acid (Scythe) are nonselective, contact herbicides that kill or injure any vegetation they contact. They kill annual weeds, but only "burn off" the tops of perennial weeds. Glyphosate (Roundup Pro and others) is a systemic herbicide. It is translocated to the roots and growing points of mature, rapidly growing plants and kills the entire plant. It is effective on most annual and perennial weeds.

F. Disease Control

Turfgrass

Dollar Spot

Dollar spot affects small, circular areas of turf, about 1 to 5 inches in diameter. The spots may merge to form large, irregular areas. Leaves appear water-soaked at first, then later turn brown. They often have a reddish band extending across the leaf. Fine, white, cobwebby hyphae (fungal threads) may be seen in early morning.

Bentgrasses, bermudagrasses, bluegrasses, fescues, ryegrasses, and annual bluegrasses are susceptible to dollar spot. The fungus survives in soil as sclerotia, which are tiny, hard, often dark, resting bodies. The disease is common near the coast, especially on creeping bentgrass and annual bluegrass. Moderate temperatures (60° to 80°F), excess moisture or water stress, fog, and excess mat and thatch favor dollar spot. Turf deficient in nitrogen tends to develop more dollar spot than turf adequately fertilized.

Chemical Control

Fungicides are usually needed to control this disease, especially on closely clipped grass. If the disease has been present in previous years, apply fungicide in early spring or fall before disease develops. The following fungicides are registered for use to control this pest: Fenarimol (Rubigan), Triadimefon (Bayleton), Iprodione (Chipco), Chlorothalonil (Daconil), Mancozeb (Fore), and Thiram (various).

Cultural Control

Keep thatch to a minimum. Irrigate only when needed to a depth of 4 to 6 inches, but do not stress the plants between irrigations. Apply adequate nitrogen. Maintain good air circulation by keeping the turf mowed and pruning barrier trees and shrubs. Composed top dressings may suppress dollar spot.

Fairy Ring

Fairy ring appears as a dark green band of turf that develops in a circle (from 10 to 20 cm up to 10 m) or semicircle in moist turf; mushrooms may or may not be present. Frequently, just behind the dark green band is an area of sparse, brown, dying grass caused by lack of water penetration. A second ring of thin dying grass may appear inside the circle. Weeds commonly invade infested areas.

All grasses are susceptible to fairy ring, which is caused by several species of mushroom-forming fungi. In northern and central California, the predominant fungus is Marasmius oreades. Lepiota spp. Are predominant in southern California.
Fairy ring develops most frequently in soils high in undecomposed organic matter containing lignin. Thus, adding woody plant materials, such as sawdust, wood chips, bark, and other uncomposted material, favors fairy ring development.

Chemical Control

Fairy ring can be eliminated by removing the turf and root zone containing the white, cottony mass, and by fumigating the soil.

Cultural Control

Apply adequate nitrogen. Aerate soil for better penetration and water heavily in holes for several days; soil wetting agents may improve water penetration. Dethatch the turf because fairy ring often develops in soils with high levels of thatch. In some situations, replace infested soil. If fairy ring symptoms consist only of mushrooms and there is no zone of dark green grass, the mushrooms can be raked off and disposed of. While this will not weaken or control the fungus, it will improve the turf's appearance.

Leaf Spot

Leaf spot occurs on leaf blades, sheaths, and stems as circular to elongated purplish or brown spots with brown colored centers and purplish to dark brown borders. Leaf spots occur on leaves throughout the turf, indicating spread by windborne spores. Crown and roots are frequently affected with a dark brown rot. Plants with crown infections are weakened and may die in hot, windy weather, resulting in a thinning out of the turf in scattered areas.

Bentgrasses, bluegrasses, fescues, and ryegrasses are susceptible to leaf spot. The fungus survives in infected grass plants or grass debris and may be seedborne. The spores are airborne.

The disease is favored by warm temperatures (70° to 90°F) and high humidity. It is most damaging on closely clipped turf. Leaf spot is more severe under high nitrogen fertilization.

Chemical Control

Leaf spot usually is not serious enough in California to warrant the use of fungicides. However, there are several fungicides registered for use. They include: Captan (various), Chlorothalonil (Daconil), Iprodione (Chipco), Maneb (various), Mancozeb (Fore), Myclobutanil (Eagle), PCNB (Turfcide), and Thiram.

Cultural Control

Reduce shade and improve soil aeration and water drainage. Avoid dry spots, overfertilizing with nitrogen, and clipping the grass too short.

Powdery Mildew

Powdery mildew causes grayish white, cobwebby growth to develop on the upper leaf surface, at first in isolated patches, then spreading to give a grayish white appearance to the leaves. In advanced stages of the disease, the leaf blades may turn pale yellow.
All grasses are susceptible to powdery mildew, but it is most severe on Kentucky bluegrass and fescues. Powdery mildew is most injurious in shady areas with high humidity and poor air circulation with temperatures at about 65°F.

Chemical Control

Fungicides are generally not necessary except in severe cases. The following pesticides can be used to control extreme problem areas: Triadimefon (Bayleton) and Fenarimol (Rubigan).

Cultural Control

Improve air circulation and reduce shading. Plant less susceptible species in powdery mildew prone areas. Supply adequate moisture and fertility, and raise the moving height.

Rust

Rust begins as small yellow spots on leaves and stems. These spots develop into elongated, reddish brown pustules. The pustules contain reddish spores that adhere to your fingers when the pustules are rubbed. Rust kills leaves and debilitates plants when it is severe. The turf quality is affected because of the yellowish color and reduced plant vigor.

Bluegrass, ryegrasses, zoysiagrass, and tall fescue are susceptible to rust. The disease overwinters in infected grasses. Moderately warm, moist weather favors rust development. Moisture in the form of dew for 10 to 12 hours is sufficient for the spores to infect plants.

Chemical Control

A fungicide may be effective at times of the year when the grass is growing slowly. At other times, manage this disease with proper mowing, fertilizing, and irrigation. The following are registered fungicides for

control of this pest: Triadimefon (Bayleton), Chlorothalonil (Daconil), Maneb (various), Mancozeb (Fore), and Myclobutanil (Eagle).

Cultural Control

Keep plants growing rapidly with adequate but not excessive nitrogen fertilization and irrigation. Provide good air movement on surface of grass. Mow the grass at weekly intervals and remove the clippings to lower the number of spores. Avoid irrigating late in the day. Turfgrass comprised of different grass species fares better against rust than turfgrass composed of a single species.

Other Issues – Reduced Risk Options

Dollar spot, fairy ring, leaf spot, powdery mildew, and rust are recognized pests of turf. These diseases are often found when environmental conditions exist that favor their development. Disease control is often completed using cultural practices and in some cases using fertilizers. A common problem, which causes fungal diseases, is improper irrigation practices. Wet soil will allow these organisms to develop and cause dieback. Aerating of soils and monitoring irrigation practices will largely reduce turf disease problems. In most cases, pesticide control of fungi is not necessary and may not be effective. Proper mowing, irrigation, fertilizer application and aerating will help manage most turf diseases.

Public Health Issues

Salmonella

Salmonella is a bacterium, which causes an infection called salmonellosis, of the gastrointestinal system (the stomach and intestines) in humans and animals. It is one of the major causes of gastrointestinal infections in the U.S. today. Although the disease is usually limited to the gastrointestinal system and most infected people do not experience any serious medical complications, the salmonella organism can spread to other systems of the body such as the blood and bone. This may cause serious complications in very young, very old, or debilitated individuals. About two thousand different strains of salmonella have been identified.

A salmonella infection is usually acquired by eating food which has been contaminated by the bacterium and has not been properly prepared or cooked. The infection may also be spread person-to-person when hands, inadvertently contaminated with an infected person's stool, are brought into contact with the mouth.

Salmonellosis can be prevented by practicing good hygiene before eating and when preparing food. In addition, it is important to cook food items thoroughly. Follow extra precautions when using animal-derived food products such as eggs, poultry, meats, and dairy products.

Some general guidelines are:

- Always thoroughly wash your hands with soap and water before meals, before preparing foods, after using the bathroom, after changing diapers, and after playing with your pets.

- When using animal-derived food products, make sure all food is thoroughly cooked, especially poultry and eggs.

- Do not eat raw or cracked eggs, unpasteurized milk, cheese made with unpasteurized milk, or any other unpasteurized dairy product.

- Avoid contaminating any food which will not be cooked such as raw vegetables, with animal-derived food products. For example, wash your hands and all utensils and surfaces which have been in contact with raw poultry before you make a salad.

- Control of cockroaches in food preparation areas is very important. These insects can mechanically carry this bacterium.

G. Vertebrate Control

Rats and Mice

The Norway rat, house mouse, deer mouse, and gophers are the most common rodent problems in California schools. Proper identification is needed before control is started because the pest management program will differ for each species. Mice such as the deer mouse presents only a seasonal problem in the fall and winter while the house mouse and Norway rat are year-round pests with the potential for serious damage/infestation. Gophers mine the soil and create mounds. These conditions create hazards when present in playing grounds and turfgrass areas.

In general, Norway rats are large, robust rodents with a blunt muzzle, small eyes, and short, rounded ears. Coloration is grizzled reddish to grayish brown with a gray to yellowish-white belly. They may range in size from 7-18 ounces and reach 11 inches at maturity. Their tails are hairless and shorter than their head and body.

The house mouse is smaller and more slender than the Norway rat. Its eyes are small and ears are quite prominent. The muzzle is pointed. The average size of a house mouse is 3 inches and they weigh 1 ounce or less. House mice are light brown to dark gray in color with a lighter colored belly. Its tail is about as long as its head and body.

The deer mouse is approximately the same size as the house mouse but it is bicolored (i.e. while bellies and feet and white undersurface of the tail) which easily distinguishes it from the house mouse. Deer mice have large eyes, which also distinguish them from house mice.

Damage

Rats and mice cause damage by gnawing, urinating, defecating, and nesting. The damage to food is much greater as a result of contamination than it is from actual loss from feeding. Deer mice are also capable of transmitting the Hantavirus, a serious, often fatal, human respiratory disease. Signs of rodent activity includes live or dead animals, feces, or gnaw marks. The use of light talcum powder or chalk dust can determine harborage, runs, or entry points. Footprints or tail marks in the dust will indicate activity. Vacuuming or sweeping of pellets or gnawing debris and monitoring for new signs

will also indicate continued activity. Non-toxic food blocks can be used to monitor activity as well. Glue boards can be used not only to catch mice but as a monitoring tool to detect possible activity.

Chemical Control

There are several rodenticides available. They should be used with caution in and around schools. Place bait in tamper-proof bait stations in areas that are not accessible to children. Snap traps and glue boards can be placed inside bait stations as well to keep them away from children.

In general, anticoagulant rodenticides, such as chlorophacinone, are recommended over the newly developed anticoagulants. These anticoagulants last for only a few days in a dead rodent body so that they pose less of a hazard to non-target organisms than some other rodenticides such as brodifacoum, which can last for many months.
Anticoagulants work by preventing blood from clotting. Rodents eat small doses of these chemicals over several days and eventually die from internal bleeding.

Parafinized bait blocks are useful in wet situations where dampness could spoil other baits. These blocks must be wired to the bait station so they cannot be dragged away.

Alternatives

Many rats and mice have become resistant to some anticoagulants. This means that the rodents can eat the anticoagulant and not sicken or die. Resistance to a chemical should be suspected if the bait is eaten regularly but the same or a greater number of rodents, holes, droppings, etc. continue to be seen. Alternating the use of different rodenticides may prevent the development of resistance.

Cultural Control

Good sanitation is essential in rodent control. Eliminate all sources of water, shelter, and food. Store food in rodent-proof containers or structures. No food should be stored in lockers overnight. All food should be drained and sealed in plastic bags. Clean trash containers regularly and make sure containers have tight fitting lids.

Identify and seal all entry points. Mortar, sheet metal, or hardware cloth can be used around pipes, sewer outlets, and small openings.

Trim shrubs, grass and vines so that a 12-18 inch vegetation barrier is maintained adjacent to the foundation of buildings. An alternative is to provide a soil sterilization control area in this location.

A trapping program should be in place in critical storage and food handling areas in all schools as a preventative/monitoring program. Traps should be checked at least once a month. Glue boards and live traps such as catch-all traps can be placed in areas away from foot traffic and are most effective when placed in areas along walls and runways.

Biological Controls

Some institutions maintain cats for protection against rodents. Cats can reduce a mouse population but seldom eliminate it. They can be a deterrent to new mouse immigration, although it is entirely possible to have alert cats and still have mice present.

Cats can kill rats as well, especially young rats; however, as with mice, cats are not a guaranteed rate deterrent. Owls and snakes are rat predators, so when considering the use of chemical control techniques, remember that depending on the toxicant used, these predators can be killed by consuming poisoned rats.

Other Issues - Reduce Risks Options

There is no evidence to show that electronic devices either kill rodents or prevent them from entering buildings. These devices are ineffective in controlling rodents and insects. They do not prevent pests from entering an area, and that the sound does not cover the area advertised.
Many schools have concerns about the ethical implications of killing rodents slowly by trapping. Snap traps are probably the most humane in that regard because they kill the animals swiftly. These concerns for the animals can be turned into motivation for habitant modification and other strategies that exclude rodents and eliminate their food supply, thus reducing the numbers that have to be directly killed. Traps should be inspected daily to remove rodents that have been caught

Diseases

Rodents harbor diseases, which can cause serious health problems. The following diseases can be associated with mice and rats:

- Bubonic plague (Black Death)
- Salmonellosis
- Lymphocytic choriomeningitis
- Rickettsialpox (or vesicular rickettsiosis)
- Leptospirosis, or infectious jaundice
- Rate bite fever (Haverhill fever, Sodoku)
- Tapeworms
- Favus, ringworm
- Murine typhus, or endemic typhus
- Hantavirus Pulmonary Syndrome (HPS)

Feral Cats

Feral cats can often be found near structures and around school grounds. These animals can harbor disease and pests, which could create a health problem if children were to come in contact with them. They can become a nuisance if large populations exist near inhabited buildings.

Chemical Control

No chemical controls are available to reduce or eliminate a feral cat problem.

Cultural Control

The most effective way to control feral cats is to catch them in live traps. Animals should be turned over to local animal control agencies when trapped.

Skunks

Striped skunks are members of the weasel family (Mustelidae). They are generally considered beneficial because of their diet that consists primarily of insects such as crickets, grasshoppers, beetles, cutworms, armyworms and other insect larvae. Skunks will also feed on small mammals such as mice, rats, shrews, moles, ground squirrels as well as garden vegetables and fruits and bird eggs.

Skunks are about the size of a large domestic cat. They are easily identified by their jet-black coat with white stripes that run from the top of their head down their back. They are primarily nocturnal and are most active from early evening through most of the night. Although they don't actually hibernate, skunks are less active during the winter. Litters are born in early spring with four to six young per litter. The young venture out on their own in fall.

Damage

Skunks pose a problem when they settle in near human habitation. Their odorous musk is generally considered unpleasant at the very least and a problem for pets. Skunks also pose a problem when they dig in turf areas for insects, leaving small holes in the ground. Rabies is another serious concern wherever skunks live. Skunks are very susceptible to this viral disease and are capable of transmitting it to other mammals through direct contact such as biting. Symptoms of rabies develop more slowly in skunks than other mammals and symptoms may not appear for weeks or even months after infection. During this time, skunks are still capable of transmitting the disease. Skunks are pretty easy to identify both by sight and smell. It may take some nocturnal sleuthing to locate a den entrance on school property.

Chemical Control

There are no chemicals registered to control skunks. If you're problem results from the digging activity of skunks in turf to access grubs and other insects, the use of a least toxic insecticide to control the insect problem will likely eliminate the skunk digging problem as well. There will be a time lag between when insect treatments are implemented and skunks leave the area.

Cultural Control

Exclusion is an effective means of skunk control. Areas inhabited by skunks can be screened with ½ inch wire mesh. It is important not to screen the entrance until after the skunk has left. Sprinkle sand or flour near the entrance and look for tracks after dusk. When you are sure the skunk has left, tightly seal the opening. It is important to extend the barrier several inches below ground to prevent the skunk from digging under it.

Biological Control

There are no biological agents available for skunk control.

Gophers

The gopher (*Geomys* spp.), also called a pocket gopher, is a burrowing rodent that ranges from 6-8 inches long at maturity. It has a large head and robust upper body, which are necessary for excavating burrows.

Chemical Control

Most gopher baits are strychnine based. Anticoagulants are registered for gopher control when buried in the tunnel.

Cultural Control

Physical controls such as barriers, and trapping are useful as direct physical control measures.

Barriers such as ½ inch mesh fencing will exclude gophers from a small area. The fence must be deeply trenched into the ground to be effective. This is not likely to be practical on playgrounds or sports fields because of the considerable labor and cost involved.

Trapping is a very effective means of reducing gopher problems. You will need at least two traps. Macabee® or Victor Easy Set® spring traps are recommended.

Biological Control

Although gophers are protected by their underground habit, when they surface to remove soil, they are vulnerable to predators such as dogs, cats, raccoons, weasels, foxes, badgers, coyotes, and hawks. Bull snakes and owls are the key predators of gophers in rural areas. Encouraging barn owls through the placement of barn owl boxes may attract this predator to your area.

Pigeons

Pigeons are common around parks, and buildings. They feed primarily on grain but will feed on garbage.

Pigeons live for up to 15 years and mate for life. Breeding can occur during any season with 1-2 eggs laid per clutch. Droppings can deface buildings, spread disease, and produce odors. They can also introduce mites and ticks into a building that can bother people. Visual observation is all that is necessary to determine whether pigeons have become established in an area

Chemical Control

Avitrol can be used to control pigeons. If pigeon problems become difficult to manage, contact a licensed pest control operator.

Cultural Control

In order to successfully control pigeons, it is important to realize that feeding them will only encourage their inhabiting a site. Therefore it is important to eliminate all sources of food including hand feeding.

Other Issues – Reduced Risk Options

Exclusion is a primary means of managing pigeon problems. Blocking access to indoor roosts and screening nesting areas by screening vents, eaves, and windows will reduce the rate of establishment of pigeons into an area.

Plastic or nylon netting can be used to discourage roosting as can changing ledge angles to over 45 degrees. Sheet metal, wood, stone, and other materials can be fastened to ledges to accomplish the desired angle. Porcupine wire can be used to discourage landing. They are composed of spring-tempered nickel stainless steel prongs with sharp points extending outwards at all angles. The prongs are attached to a solid base that is installed on windowsills, ledges, eaves, roof peaks, and ornamental architecture to prevent landing or roosting. Cage traps can be a very effective tool to reduce populations of pigeons roosting or nesting on undesirable sites.

H. Challenges to Implementing Change

There are many pest management challenges facing schools. A concern not well documented is exposure level of liquid sprays used indoors or outdoors in schools. There is not a clear understanding of the exposure to liquid or aerosol sprays. Many liquid pesticides are used indoors in classrooms and kitchens. They release vapors, which may increase the potential for exposure. It is also possible that some pesticides may enter drains and add to the non-point source pollution problems impacting surface and ground water.

A second issue is the lack of documentation and central depository of information about IPM practices and pesticide use reporting. Some school districts report their pesticide use under an operator I.D. number. Others report pesticides under the Pest Control Operator license number. Still other schools maintain internal records of pesticide use and do not report the use to the state. A challenge is to devise a system of reporting and establish baseline use information for all schools. It was difficult to obtain pesticide use report data covering use in various schools. The data collected came in the form of the original pesticide use reports, electronic summary queried from County agricultural commissioners, and from the 1998 DPR pesticide use report CD covering the statewide use report record. There was no way to access this data in one media.

The following data on pesticide use originated from four separate school districts. It was compiled from various record sources and represents a complete year of activity. In turn, the information was put in the tables below.

School A

EPA #	NAME	AMT	UT	PEST	ACTIVE ING
524-475	ROUNDUP PRO	25.6	GA	WEEDS	GLYSOPHATE
62719-113	SURFLAN	1.9	GA	WEEDS	
464-554	TURFLON	16	OZ	WEEDS	TRICLOPYR
10182-367	FUSILADE	12	OZ	WEEDS	FLUAZIFOP-BUTYL

279-3062	DRAGNET SFR	5	GA	INSECTS	PERMETHRIN
10182-361	DEMAND CS	4	GA	INSECTS	LAMBDACYHALOTHRIN
64248-6	MAXFORCE ANT GRANULARS	4	LB	ANTS	

School B

EPA #	NAME	AMT	UT	PEST	ACTIVE ING
64248-6	ANT/ROACH KILLER GRANULAR BAIT	481	oz	INSECTS	
35977-1-2217	ATRIMMEC	5	oz	PLANT GROWTH REG	DIKEGULAC SODIUM
499-294	AVERT	0.25	oz		
3125-121	BAYGON	64	oz	INSECTS	PROPOXUR
44313-4-550	BORID	20	oz		
275-37	DIPEL 2X	5	oz	INSECTS	BACILLUS THURINGIENSIS
1813-362	DIREX 80 DF	1642	lb	WEEDS	DIURON
279-3062	DRAGNET FT	86	oz	INSECTS	PERMETHRIN
9444-131	DRAX ANT KILL GEL	33.5	oz	INSECTS	
4816-353	DRIONE	9	oz	STORED INSECT PESTS	PYRETHRINS
10182-393	FUSILADE II	93	oz	WEEDS	FLUAZIFOP-BUTYL
524-465	MANAGE	0.25	oz	WEEDS	HALOSULFURON-METHYL
33955-483	MECOMEC	219	pt	WEEDS	MCPP
53219-6	M-PEDE	155	oz	INSECTS	INSECTICIDAL SOAP
2217-728	ORNAMEC	64	oz	SELECTIVE GRASS HERB	FLUAZIFOP-P-BUTYL
499-160	OT 110	20	oz		
12455-50003	PCQ PELLETED RODENT BAIT	318.8	lb	RATS/MOLES	DIPHACINONE
2724-339-50809	PRECOR	20	oz		
499-381	PT 175 MICROCARE	1457	oz		
499-220	PT 240	17	oz		
524-308	ROUND UP	93	oz	WEEDS	GLYPHOSATE
524-475	ROUND UP ULTRA	56.9	ga	WEEDS	GLYPHOSATE
53219-7	SCYTHE	531	oz	WEEDS	PELARGONIC ACID
62719-107	SPIKE	12	lb	WEEDS	TEBUTHIURON
62719-113	SURFLAN	356	oz	WEEDS	
1471-150	TEAM	10	lb	WEEDS	TRIFLURALIN + BENEFIN
3125-380	TEMPO	57.5	oz	INSECTS	BAYTHROID
464-554	TURFLON	10	oz		TRICLOPYR
11540-1	UCD BP 300	205	oz		
36029-50003	WILCO GOPHER GETTER TYPE 2	126	oz	GOPHERS	STRYCHNINE

School C

EPA #	NAME	AMT	UT	PEST	ACTIVE ING
264-538	CHIPCO RONSTAR 50 WSP	6	OZ	WEEDS	OXASIAZON
499-228	DIAZINON	58	OZ	ANTS	DIAZINON
279-3062	DRAGNET FT	18	OZ	INSECTS	PERMETHRIN
45639-3	FICAM 1% DUST	6	OZ	YELLOW JACKETS	BENDIOCARB
524-308	ROUND UP	4	OZ	WEEDS	GLYPHOSATE
524-475	ROUND UP ULTRA	1849	OZ	WEEDS	GLYPHOSATE
499-362	WASP FREEZE & HORNET KILLER	4	OZ	YELLOW JACKETS	
36029-50001	WILCO GOPHER GETTER TYPE 1	5	LB	GOPHERS	STRYCHNINE
36029-50003	WILCO GOPHER GETTER TYPE 2	42	LB	GOPHERS	STRYCHNINE

School D

EPA #	NAME	AMT	UT	PEST	ACTIVE ING
10965-50001	RODENT BAIT DIPHACINONE	290	LB	RODENTS	DIPHACINONE
524-475	ROUNDUP PRO	452	OZ	WEEDS	GLYPHOSATE
524-445	ROUNDUP	84	OZ	WEEDS	GLYPHOSATE
524-475	ROUNDUP PRO	23.25	GA	WEEDS	GLYPHOSATE
707-174	GOAL 1.6E	6.56	GA	WEEDS	OXYFLUORFEN
62719-113	SURFLAN A.S.	128	OZ	WEEDS	
10163-21	GOWAN MALATHION 8	1.5	GA	INSECTS	MALATHION
5905-368	HELENA OMNI SUPREME SPRAY	6	GA	INSECTS	PETROLEUM OIL
5905-368-ZA	OMNI OIL 6-E	6	GA	INSECTS	PETROLEUM OIL
5905-50062	HELENA BUFFER P.S.	1.5	GA	SPREADER	

A third challenge is to deal with pesticide and integrated pest management in a proactive manner. A new proposed federal law which addresses pesticide reduction in schools has recently been introduced. Over the past two legislative cycles in California, legislation has been introduced covering school pesticide use reduction and "right to know" requirements. This legislation proposed to cancel registrations of high-hazard pesticide products, require public noticing of intended spraying and posting of warning signs in schools. The governor vetoed this legislation. Many school districts have responded to the growing concerns about pesticide use in schools. In some instances, schools have adopted policy and guidelines to deal with pest problems. Developing a flexible but uniform integrated pest management model goes beyond adopting a policy and posting signs. There must be a clear and uniform way to communicate problems and solutions and offer training and education to those involved in the day-to-day pest control activities.

A fourth issue is the new and changing pest conditions found in the state. How will maintenance managers deal with the Africanized HoneyBee and the Red Imported Fire Ants on school grounds? They can cause special problems for pest managers and create special levels of public concern over their control. Technical issues and problems can be found associated with pest resistance and pest repellency when pesticides are used. This latter issue is very important to consider when controlling cockroaches.

Another technical challenge is that access to IPM technical information and bulletins is limited to insects, especially termites, some vertebrates, and weeds in school environments. This shortfall could be addressed by forming quality teams to develop consensus on IPM practices. Experts should be called together to explain technical problems and assist in finding solutions. A single source of reliable and current information on common and exotic pests should be developed.

Food preparation must focus on food safety and deal with sanitation to control microorganisms. Many of the common sense practices to reduce microbes (salmonella, etc.) fit very well into an IPM program. A clean environment results in few pest problems. In the state, a number of schools have developed IPM programs and have reduced pesticide use. However, the challenge is to establish baseline data not only on pesticide use and pesticide cost, but the administration and management of the IPM and pesticide use system. Baseline data is needed to evaluate the "IPM Economic System." An evaluation of the system can assist in understanding of the various elements, which then can be analyzed to determine cost. In recent

years, concern for pesticide use in schools has elevated. Parents worry about undiagnosed pesticide poisoning and chronic effects to their children. Parents do not want children exposed to pesticides.

I. Innovation

A fundamental element for the successful implementation of IPM in California schools comes from over 20 years of support offered by the California Department of Food and Agriculture and California Department of Pesticide Regulation (DPR). They offered the first outreach efforts focusing on reducing risks associated with pesticide use in urban areas. They prepared IPM guidelines for a series of urban pests. These documents became the basis for the majority of pest management information available to the public. In 1994, DPR surveyed schools about their IPM policies and programs. It was found that 10% of the survey respondents had a policy and program in operation. Since that initial survey, several school districts have implemented successful IPM programs. The most prominent programs include a written policy approved by elected officials or top management. The policy requires there be a coordinator, training programs, records of pesticide use and pest management activities, and an annual evaluation of program results.

Various California school districts, including Fontana Unified, Los Angeles Unified, Ventura Unified, and San Diego Unified have established IPM programs and some have received the DPR IPM Innovator Award. They have established an RFP/RFQ and contractual protocols when pest control services are purchased. Many schools have established training programs for employees covering IPM. Pesticide use training is required by law for all employees who handle pesticides. Schools have collaborated with other agencies developing pest management curricula, establishing "Ag in the Classroom" programs, and developed "A Garden in Every School." Each are designed to educate parents, teachers, administrators, and the public about food, food safety, and environmental protection and pest management.

Government programs evaluate risks from a human health perspective by monitoring air and ground and surface water contamination, endangered species, beneficial organisms, and soil contamination. In addition, pesticide incidents and illness reports are investigated to determine compliance with laws. Evaluation of each incident is important in determining how to prevent problems from reoccurring.

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